fermi
national accelerator laboratory

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To: Art Greene

From: Russ Huson, Spokesman for E546

Subject: PARTICIPATION ON E546

    The physicists who have committed their support to this experiment
are:

Fermilab:

        B. Chrisman
        R. Harris (leaves June 1977)
        R. Huson
        J. Lys (leaves Sept. 1977)
        T. Murphy
        J. Schmidt
        W. Smart
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Lawrence Berkeley Lab and
Univ. of Calif. at Berkeley:

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University of Wisconsin:

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I. Introduction

Discussions between the proponents of P-459 and P-460 have
led to the formation of a collaboration to study neutrino
physics in the 15' chamber filled with a neon-hydrogen mix
with the two plane EMI utilizing a quad-triplet beam. The
groups would be Berkeley, Fermilab, Hawaii, and Wisconsin.

II. Physics

The following is a brief listing of the obvious major
problems that can be studied.

1.) Di-muon physics; strange particle production, hadron
     energy distribution, $<p_\mu/p_{\mu 2}>$, equal sign μ's etc.

2.) Tri-lepton physics $\mu\mu\mu$ μee $\mu\mu e$

3.) μ-e events. Although these are similar to $\mu\mu$ events,
     there is one major difference; namely in μe events one
     can separate which lepton is associated with the in-
     coming ν and hence clearly separate ν from $\bar{\nu}$ inter-
     actions. All the problems can be studied with μe or
     with $\mu\mu$.

4.) μ + (Energetic K_s^o or $\pi^\pm$) This class of events is of
     great interest in investigating the production of heavy
     leptons at the leptonic vertex.

5.) High Y anomolies which arise from special classes of
     events such as in 4.) and μe etc.

6.) Neutral currents production at high energies. Although
     this includes a mixture of ν and $\bar{\nu}_\mu$ strange particle
     production, W distributions, etc. it would be of con-
     siderable interest.

III. Flux

A total of 5×10^{18} protons (in several packages) would
yield a significantly large number of di-lepton events so
that a detailed study of associated phenomena could be made.
Also this experiment would yield enough tri-leptons to per-
mit a study of associated strange particles.

In the following table is given the number of observed
events for a proton flux of 5×10^{18} and a neon-hydrogen
mix of 60%.

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Table I

μ (Charg. Curr.)	80,000
$\mu\mu$ (ν_μ)	200	20 with $p_1 \cong p_2$
$\mu\mu$ ($\bar\nu_\mu$)	20
$\mu^- e^+$ (ν_μ)	500
$\mu^+ e^-$ ($\bar\nu_\mu$)	50
$\mu\mu\mu$	6
μee	10
ν_e	2,000
$\bar\nu_e$	400
N.C.	20,000

IV. Ne-H Mix

The film from P-460 is being studied quantitatively. The problems associated with high energy and low energy electrons will be studied. A decision as to the mix will be made in a few weeks.

W. F. Fry
March 10, 1977

Russ Huson is to be the principal Investigator

F. R. Huson
March 7, 1977

E460 DATA SHEET

Data with 3-view B.C. and EMI	17,000 pictures
Total protons on target	2.5×10^{17}
Dimuon acceptance of 2-plane EMI (Monte Carlo)	.35
Target 62% Neon - 38% H. (track length $\geq$ 60 cm)	15 tons
Expected neutrino charged currents	4000 events
Expected antinuetrino charged currents	400 events
Expected $\mu^-\mu^+$ from ν (.01 x .35 x 4000)	$\sim$ 14 events
Expected $\mu^+\mu^-$ from $\bar{\nu}$ (.01 x .35 x 400)	$\sim$ 1 event

Candidates. P$\mu \geq$ 4 GeV/c	$\mu^- \mu^+$	10 events
	$\mu^-\mu^-$	0 event
	$\mu^+\mu^+$ (EMI hit prob. for 1 tr. is .008)	1 event
	Total	11 events

Background ($\mu^-\mu^+$ events with other hits in EMI, real?)	3 events
($\mu^+\mu^+$ punch-through, decay, real?)	1 event
Good events (best estimate now available)	
4-fold coincidence $\left\{ \mu^-\mu^+ \text{ from } \nu \right.$	6 events
in EMI $\left. \mu^+\mu^- \text{ from } \bar{\nu} \right.$	1 event
Total	11 events

Note: The 7 good events are <u>clean</u> and the expected punch-through and decay
background is $\lesssim$ 10% or 1 event. One event has a K^0_S, no others have
observable V's.

If the second plane is "turned" off, we pick up the following additional
multimuon events, which we believe are all background, i.e., punch-through.

11	$\mu^-\mu^+$
3	$\mu^-\mu^-$
2	$\mu^+\mu^+$
1	$\mu^-\mu^-\mu^-\mu^+$
1	$\mu^-\mu^+\mu^+\mu^+$
Total 18	

F. R. Huson
March 8, 1977

One-Page Summary

E460 – HIGH-ENERGY NEUTRINOS AND ANTINEUTRINOS IN A BUBBLE CHAMBER PLUS 2-PLANE EMI

The unique feature of this experiment is the positive muon identification made possible by the 2-plane EMI. With the addition of 14 more chambers making a total of 39 chambers (plane 1 - 3 x 6 = 18, plane 2 - 3 x 7 = 21), the acceptance for dimuon events produced by neutrinos from the quadrupole-triplet beam is about .35 for the 25-chamber configuration used in December and is expected to be about .50 for the new 39-chamber array.

The experimenters request 5×10^{18} protons so that a clean sample of about 200 dimuon events can be obtained. Obviously, a sample of greater than 200 μe events will also be obtained. Analysis of the dimuons is easier, however, both $\mu\mu$ and μe can be analyzed. An experiment of this nature is essential to understanding dilepton production by neutrinos. Since this experiment gives a clean sample of dileptons, physics effects larger than ~10% of the sample can be observed; for example, charm, new quarks, etc.

Since there would be $\gtrsim 5000$ antineutrino events with positive muon identification in both EMI planes, the experimenters believe they can study the high y anomaly. The EMI planes are arranged to give greater acceptance for positive muons. If the high y anomaly is due to charm production, it may be possible to observe the hadronic decay modes in mass distributions.

Whereas an experiment in this apparatus with 2×10^{18} protons will produce valuable data, 5×10^{18} protons will give a more definitive experiment. For this reason, we propose collaborating with Wisconsin, since we believe one experiment of 5×10^{18} protons is much better than 2 experiments each of 2×10^{18} protons.